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**Notes:**

1. Untranslatable words are replaced with asterisks (\*\*\*)�.
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## CLAIM + DETAILED DESCRIPTION

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**[Claim(s)]**

[Claim 1]In welding of a high intensity wire rod which welds by grasping weld line material with 2 rate electrodes, and comparing, A butt welding method of a high intensity wire rod regrasping a position of prescribed distance from a joined part of this wire rod further welded with the electrode, energizing again, and performing APUSSETTO of the specified quantity after welding by grasping, energizing and comparing a position of prescribed distance with this electrode from a junction end of weld line material.

[Claim 2]Two rate electrodes which have a parallel groove part which a high intensity wire rod compares and grasps weld line material in welding, and the opening whose diameter a welding side edge of this parallel groove part expanded in the shape of a trumpet are used, It welds by grasping, energizing and comparing a position of prescribed distance from a junction end of weld line material with this electrode, A butt welding method of a high intensity wire rod regrasping a position of prescribed distance from a joined part of this wire rod further welded with the electrode, energizing again, and performing APUSSETTO of the specified quantity after making a spindle type joined part whose diameter a welding part expanded form in this weld line material.

[Claim 3]A butt welding method of the high intensity wire rod according to claim 1 or 2 setting to 0.1d-0.8d said amount of APUSSETTO which is compared and is performed after welding when setting a path of weld line material to d.

[Claim 4]A high intensity wire rod characterized by comprising the following compares, and it is a welding machine.

Two rate electrodes which grasp weld line material.

Weld by energizing, while this electrode grasps a position of prescribed distance from a junction end of weld line material and pressurizes a junction end, and this wire rod comparing, and the electrode regrasps a position of prescribed distance from a joined part of this welded

wire rod further, A control means which operates so that it may energize pressurizing a junction end again and APUSETTO of the specified quantity may be performed.

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]Heat-treated high intensity wire rods, such as a steel rod wire rod used for a concrete pole, a beam, etc., compare this invention, and it relates to the method and welding machine of welding.

[0002]

[Description of the Prior Art]For example, the hoop line as a main reinforcement and auxiliary sources for shearing reinforcement who surround this main reinforcement group is used for steel rod wire rods, such as a concrete pole and a beam. There are a method of rolling a long wire rod continuously and making it forming in the surroundings of a main reinforcement group as this hoop line, and the method of allocating in each surroundings of a main reinforcement group one hoop line rolled one every turn. Although the hoop line using the wire rod of the former long picture is advantageous in intensity at a point without a welding part, field operation has difficulty. Therefore, the method of the latter which allocates the hoop line of 1 turn which created many beforehand on the spot is taken. It is desirable for the breaking force of a welding part to be it of a base material and more than equivalent, as not fractured in a welding part in this 1 turn hoop line.

[0003]

[Problem to be solved by the invention]However, after it fabricates the wire rod cut by predetermined length to specified shape, the above-mentioned 1 turn hoop line compares the both ends, welds, is created, is \*\* and has the problem that the intensity of the welding part by the thermal effect of a welding part falls from a base material. When manufacturing 1 turn hoop line and using the wire rod of low intensity, since there is little intensity change by the thermal effect of a welding part, it seldom becomes a problem. However, in using the high intensity wire rod which heat-treated like PC steel stick, the mechanical strength of the hoop line which the intensity of the welding part fell from the base material with welding heat, and was completed falls, and it loses the meaning which uses a high intensity wire rod. Therefore, in order to guarantee the intensity of a hoop line, although a welding part can be re-heat-treated, and mechanical properties can be recovered or a still thicker wire rod can also be used, it is in man day and economically disadvantageous.

[0004]On the other hand, [ as anti-earthquake procedures ] [ request / of improvement in shearing intensity, such as a reinforced column and a beam, ] Use of the steel stick specified

to PC steel stick standard and the high intensity wire rod of equivalent intensity is requested also from auxiliary sources' hoop line, and when using such a high intensity wire rod, development of the welding process with which the breaking force of a welding part becomes equivalent to it of a base material part is desired.

[0005]Then, these people indicated the invention of "the electrode of high intensity 1 turn auxiliary sources and its welding machine for manufacture" previously (JP,H6-99286,A).

[0006]This invention develops said invention further and aims to let the breaking force of a welding part provide the butt welding method and welding machine of a high intensity wire rod which serve as it of a base material more than equivalent also for the steel rod wire rod which uses the heat-treated high intensity wire rod.

[0007]

[Means for solving problem][ to achieve the above objects the butt welding method of the high intensity wire rod of this invention ] In welding of the high intensity wire rod which welds by grasping weld line material with 2 rate electrodes, and comparing, After welding by grasping, energizing and comparing the position of prescribed distance with this electrode from the junction end of weld line material, the position of prescribed distance is regrasped from the joined part of this wire rod further welded with the electrode, it energizes again, and APUSETTO of the specified quantity is performed.

[0008]Namely, the butt welding method of this invention makes the path near the welding part thicker than the diameter of a base material by performing APUSETTO between heat for the neighborhood of a welding part, after welding by usual having compared the steel rod wire rod first and making the usual welding bulge form, and. [ a butt welding method ] Recovery of deterioration of the mechanical properties of the joined part by the hot welding heat produced in the first welding is aimed at, and breaking force of a welding part is made into it of a base material part more than equivalent. Recovery of the mechanical properties of this welding part is presumed to be what is depended on immobility transposition increasing according to the tempering effect by heating in the case of APUSETTO between heat, and the dynamic distorted prescription effect by processing between \*\*.

[0009][ the butt welding method of the high intensity wire rod of this invention ] Two rate electrodes which have a parallel groove part which a high intensity wire rod compares and grasps weld line material in welding, and the opening whose diameter the welding connection side edge of this parallel groove part expanded in the shape of a trumpet are used, It welds by grasping, energizing and comparing the position of prescribed distance from the junction end of weld line material with this electrode, After making the spindle type joined part whose diameter the welding part expanded form in this weld line material, the position of prescribed distance is regrasped from the joined part of this wire rod further welded with the electrode, it energizes again, and APUSETTO of the specified quantity is performed.

[0010]Namely, if the end by the side of a welding part welds by grasping a steel rod wire rod with 2 rate electrodes which have the grasping part which carried out the opening to the shape of a trumpet, and usual comparing first, The spindle type joined part whose diameter the welding part to which the horn aperture part of the electrode imitated the opening of the electrode by APUSSETTO between heat at the time of welding sure enough in the role of the dice at the both sides of welding bulge expanded is formed. Thus, since a spindle type joined part thicker than the diameter of a base material is formed near the welding part, even if the fall of the mechanical strength by welding heat arises in a welding part, equivalent to a base material part or the breaking force beyond it will be acquired by the increase in a cross-section area, and the breaking force of a base material is guaranteed as the whole hoop line.

[0011]In the welding process of this invention, after welding by usual [ said ] comparing, recovery of deterioration of the mechanical properties by the hot welding heat of the welding part which performed APUSSETTO between heat and produced the neighborhood of a welding part in the aforementioned welding is aimed at, and improvement in the mechanical properties of the spindle type joined part made to form by the first welding is aimed at. The mechanism is as having mentioned above.

[0012]In order to obtain the most desirable mechanical properties of a joined part, when setting the path of a welding steel rod wire rod to d, as for the amount of APUSSETTO performed after welding of said beginning, it is desirable to be referred to as 0.1d-0.8d, and they are 0.4-0.5 more desirably. It is because the above-mentioned effect cannot demonstrate enough if the amount of APUSSETTO is too small, but it will be distorted if too large, and the prescription effect is no longer acquired.

[0013]The high intensity wire rod of this invention compares, and, [ a welding machine ] It welds by having 2 rate electrodes which grasp weld line material, energizing, while this electrode grasps the position of prescribed distance from the junction end of weld line material and pressurizes a junction end, and this wire rod comparing, It had the control means which operates so that it may energize while the electrode regrasps the position of prescribed distance from the joined part of this welded wire rod and pressurizes a junction end again, and APUSSETTO of the specified quantity may be performed.

[0014]Namely, this invention compares, and a welding machine welds by carrying out prescribed distance movement in the direction of a welding part, and usual comparing, setting, grasping and energizing weld line material for a prescribed interval from a junction end with 2 rate electrodes first. And an electrode moving in the direction which opens a wire rod wide and separates from a welding part, grasping a wire rod again in a prescribed position, energizing again, and heating a wire rod, if welding is completed, it operates so that specified quantity APUSSETTO of the wire rod welded in the direction of a welding part by carrying out prescribed distance movement may be carried out. Since such an operation is automatically performed by

the control means, it is economized and uniform welding can be performed.

[0015]

[Mode for carrying out the invention]Hereafter, one embodiment of illustration of this invention is described concretely. the figure which the high intensity wire rod of this invention embodiment compares drawing 1, and illustrates the process of operation of welding, the figure in which drawing 2 shows one example of the electrode shape, the figure in which drawing 3 shows the microscope observation position of the welding specimen section of this invention, the block diagram in which the high intensity wire rod of this invention embodiment comparing drawing 4, and showing the control part of a welding machine, and drawing 5 come out. It is a flow chart of the high intensity wire rod of this invention embodiment which compares and shows operation of welding.

[0016]The electrode 1 of drawing 2 consists of the opening 4 in which the parallel groove part 3 and welding side edge of the path approximated to the diameter of a wire rod which grasps weld line material (henceforth a wire rod) carried out the opening to the shape of a trumpet, and a pair of provided symmetrical gripping members 1a and 1b. The gripping members 1a and 1b are driven so that it may be made from electric conduction materials, such as a copper alloy, it may open and close and weld line material may be grasped and opened. And the both sides of the welding part of a wire rod are grasped with two electrodes, as shown in drawing 1, it drives so that the welding part of a wire rod may be welded by pressure, and it energizes to inter-electrode [ this / two ], and compares by heating and welding a welding part by pressure, and welding is performed.

[0017]The control means 10 of drawing 4 detects an electrode position with the set part 12 which sets up CPU11, the position of an electrode, and the amount of \*\*\*\*\*, and becomes an electrode from \*\* pressure and the control section 13 which drives and controls the voltage current of an electrode. The position-in-readiness set part 14 which sets the position in readiness T0 of an electrode to the set part 12, The welding \*\*\*\*\* set part 15 which sets up amount of \*\*\*\*\* T1-T2 (the electrode position at the time of making a T1:welding part weld by pressure between the colds, T2: electrode position after welding) of welding, The initial positioning part 16 of APUSSETTO which sets up the electrode position T3 at the time of starting APUSSETTO, and the amount set part 17 of APUSSETTO which sets up amount of APUSSETTO T3-T4 (T4: electrode position after APUSSETTO) are formed. The electrode current set part 22 which sets up the electrode current at the time of welding and the electrode current value at the time of APUSSETTO is formed. A proper value is experimentally provided by \*\*\*\* of a work, the quality of the material, etc. in welding current and APUSSETTO current, respectively. The electrode position detector 18, the electrode control part 19, and the power supply controller 20 are formed in the control section 13. The electrode control part 19 moves the electrode 1 to the position of the numerical value set as said set part 12 by the electrode

transportation device 24 based on the position signal of the electrode position detector 18, opens and closes an electrode by the electrode opening and closing means 23, and grasps and opens a work.

[0018]Hereafter, this invention compares using the flow chart of drawing 1, drawing 3, drawing 4, and drawing 5, and operation of a welding machine is explained. First, the predetermined numerical value which was adapted for the path of weld line material is set to the set part 12 (Step 1). that is, Electrode position [ at the time of starting the position in readiness T0 of the electrode at the time of setting a work to an electrode, amount of \*\*\*\*\* T1-T2 of welding, and APUSSETTO ] T3 and amount of APUSSETTO T3-T4 is inputted into the position-in-readiness set part 14, the welding \*\*\*\*\* set part 15, the initial position 16 of APUSSETTO, and the amount set part 17 of APUSSETTO, respectively. The welding current value according to \*\*\*\* of weld line material is inputted into the electrode current set part 22.

[0019]Next, a push on the start switch 15 will move the electrodes 1 and 1 of both sides to the position in readiness T0 where drawing 1 (a) was set up via CPU11 and the electrode control part 19 (Step 3). (Step 2) At this time, the electrode 1 is in the state where it opened. Set a welding part as the center between two electrodes here, and the parallel groove part 3 of the electrode 1 is equipped with the weld line material (henceforth a work) S (Step 4), the electrode open/close switch 26 -- "-- if closed" is used (Step 5), the electrodes 1 and 1 of both sides will close via CPU11, the electrode control part 19, and the electrode opening and closing means 23, and the work S will be grasped. The electrodes' 1 and 1 grasping of the work S will carry out \*\* pressure of them so that the welding part of the work S may be made to weld by pressure via the electrode transportation device 24 (Step 6). Thereby, the welding end of a work is crushed, an electrode moves in the direction of a welding part slightly, and moves to the position of T1 (drawing 1 (Step 7) (b)), and this T1 is memorized by CPU11. The welding current simultaneously inputted into the electrodes 1 and 1 of both sides from the power supply 25 via CPU11 and the power supply controller 20 at the electrode current set part 22 energizes, and resistance heating of the contact surface is carried out (Step 8). Since the electrode 1 is pressurized in the welding direction by the electrode transportation device 24 if the work S between the electrodes 1 and 1 of both sides is heated and it softens, advance movement is carried out (Step 9). Since amount of welding \*\*\*\*\* T1-T2 is inputted into the welding \*\*\*\*\* set part 15, an electrode moves to the position of T2 of drawing 1 (c), and stops in the position of T(Step 10) 2, the amount of \*\*\*\*\* of a setup compares, welding is completed (Step 11), and the welding bulge 5 as shown in a figure is formed. If it compares and welding is completed, electric power which flows into an electrode via the power supply controller 20 will be turned OFF (Step 12).

[0020]APUSSETTO [ the work S which this invention compared and said welding completed further in welding ] between heat as follows has the feature. If the above-mentioned welding is

completed and a power supply is turned OFF, an electrode will be made into \*\* via the electrode opening and closing means 23, and grasping of a work will be opened wide (Step 13). And via the electrode transportation device 24, an electrode retreats (Step 14) and moves to the position T3 inputted into the initial position 16 of APUSSETTO (drawing 1 (Step 15) (d)). passing CPU11 and the electrode opening and closing means 23, if an electrode stops in the position T3 -- the electrode 1 -- closed -- a work is again grasped as it is \*\*\*\* (Step 16), and it is pressurized in the welding direction via the electrode transportation device 24 (Step 17), and the power supply of the electrode 1 is turned ON via the power supply controller 20 (Step 18). If current flows between the electrodes 1 and 1, the work S between the electrodes 1 and 1 will be heated, but it is set up so that current smaller than welding current may flow into the electrode current set part 22 at this time, and he is trying to become a low temperature in which APUSSETTO is possible.

[0021]Since the electrode is pressurized in the welding direction and amount of APUSSETTO T3-T4 is inputted into the amount set part 17 of APUSSETTO, If the work S carries out heating \*\*\*\*\* softening, the electrode 1 will move forward, a work (Step 19), and will move to the position of the interval T4 of drawing 1 (e) (drawing 1 (Step 20) (e)). If it moves to the position of the electrode 1T4, a power supply will be turned OFF and APUSSETTO of the amount of \*\*\*\*\* of the specified quantity (Step 21) will be completed.

[0022]If APUSSETTO is completed, an electrode will be made into \*\* via the electrode opening and closing means 23, and grasping of a work will be opened (Step 22). And via the electrode transportation device 24, an electrode retreats (Step 23) and moves to the position T0 inputted into the APUSSETTO position-in-readiness set part 14 (drawing 1 (Step 24) (a)). The work S is removed from the electrode 1 in this position (Step 25), and welding operation of this invention is completed (Step 26).

[0023]Thus, in that usual compares and APUSSETTO between heat is again given for the neighborhood of a welding part after that in addition to welding, the conventional high intensity wire rod compares a device and a method of this invention, and it differs from welding greatly. That is, if a heat-treated high intensity wire rod is compared and welded with the conventional welding process, with welding heat, mechanical properties of a welding part will deteriorate and it will fracture by load lower than breaking force of a base material. On the other hand, since usual compares and APUSSETTO processing between heat of the neighborhood of a welding part is again carried out after welding in this invention, Deterioration of mechanical properties according [ transposition produced according to the dynamic distorted prescription effect on the occasion of welding ] to immobility-izing or hot welding heat which it adhered and was produced in welding is recovered, and. Since a path near the welding part becomes thicker than a diameter of a base material by APUSSETTO and a cross-section area becomes large, breaking force of a welding part can be made into it of a base material part more than

equivalent.

[0024]Since the gripping members 1a and 1b of the electrode 1 have the opening 4 whose diameter the welding part side expanded as shown in drawing 2, it compares, and in the case of welding, as shown in drawing 1 (c), the taper part 6 is formed in the both sides of the welding bulge 5, and a joined part becomes spindle-shaped. The opening 4 forms a dice, the heated inter-electrode wire rod of both sides imitates this, and this forms the shape of a spindle. Since the diameter of a wire rod near the welding part becomes larger than the diameter of a base material by this, and it is compensated by the increase in a cross-section area even if the mechanical strength near the welding part of a wire rod falls with welding heat, as for breaking force, it of a base material part and more than equivalent are obtained.

[0025]In this invention, since APUSSETTO processing between heat of the neighborhood of a welding part is further carried out after welding, deterioration of immobility-izing or mechanical properties adhere and according to hot welding heat is recovered for the transposition which the dynamic distorted prescription effect produced in the joined part by re-heating of APUSSETTO processing as mentioned above, and was produced on the occasion of welding. As for joined part shape, as shown in drawing 1 (d), two steps of taper parts 6 and 7 are formed, and the path of a joined part becomes larger than the diameter of a base material. Since the breaking force of a welding part is further secured beyond the breaking force of a base material, use of the wire rod of a byway is attained and the hoop line compared and welded by this can carry out a weight saving.

[0026]

[Working example]PC steel stick which 13.12 mm phi in diameter heat-treated was used, it compared by the method and the conventional method of this invention, and the welding experiment was conducted. The mechanical properties of the wire rod are shown in Table 1.

That is, the tensile strength of the breaking force of a base material is about 149 kgf(s)/mm<sup>2</sup> in about 20 ton(s).

[0027]

[Table 1]

試験片母材の機械的性質

直径 mm	破断荷重 ton	引張強さ kgf/mm <sup>2</sup>	降伏点 kgf/mm <sup>2</sup>	降伏比 %	破断伸び %	絞り %
13.12	20.08	148.6	141.5	95.2	10.0	61.7

[0028]It compared and compared by performing welding by the method and the conventional method of this invention. The method of this invention made the electrode spacing of each stage the conditions shown in Table 2, and performed it using the electrode which has an opening of the shape shown in drawing 2.

[0029]

[Table 2]

突合せ溶接・アセットの条件・

溶接条件			アセット条件				
電極間隔 mm		据込み量 mm T1-T2	据込み比 T2/T1	電極間隔 mm		据込み量 mm T3-T4	据込み比 T4/T3
T 1	T 2			T 3	T 4		
3 0	5	2 5	0. 1 7	2 0	1 5	5	0. 7 5

[0030]The comparison result of having done the tensile fracture examination for the specimen which welded by this invention comparing on the above-mentioned conditions, and the specimen which welded by the conventional method comparing with the gage length of 10 d is shown in Table 3.

[0031]

[Table 3]

溶接試験片の破断試験結果

試料 No.	本発明の溶接方法				従来の溶接方法			
	破断荷重 ton	破断伸び		破断点	破断荷重 ton	破断伸び		破断点
		mm	%			mm	%	
1	20.15	12.8	9.8	母材部	19.35	10.8	8.2	接合部
2	21.05	13.0	9.9	母材部	15.25	5.5	4.2	接合部
3	19.86	12.8	9.8	母材部	16.10	7.2	5.5	接合部
4	20.58	12.4	9.5	母材部	18.38	9.1	6.9	接合部
5	21.11	13.3	10.1	母材部	15.14	5.5	4.2	接合部
平均	20.55	12.9	9.8		16.84	7.6	5.8	
R	1.25	0.9	0.6		4.12	5.3	4.0	

[0032]As shown in a table, all the specimens of this invention method were fractured in the base material part, and did not change breaking force to breaking force 20.08ton of the base material shown in Table 1 by an average of 20.55 ton(s), either, but their fracture growth was also equivalent to the base material. On the other hand, by the conventional method, all were fractured by the welding part or the joined part of the neighborhood, there is much variation, and breaking force could be given to 83% of the breaking force of an average of 16.84 ton(s) and a base material, but fracture growth also decreased from the base material.

[0033]The result of having performed microscope observation about the section of the joined part of a specimen is shown in Table 4. Table 4 is the result of carrying out microscope observation from the welding side shown in drawing 4 about position [ of the axial center line of 0-10-mm distance ] (a) - (d). As shown in a table, this invention compares, and according to the method of welding, it is an organization equivalent to a base material from the welding side in the position of 5 mm.

[0034]

[Table 4]

溶接試験片の顕微鏡観察結果

記号	観察位置 溶接面からの 距離 mm	接合部の顕微鏡組織	
		本発明の溶接方法	従来の溶接方法
(a)	0	マルテンサイト組織	マルテンサイト組織
(b)	5. 0	焼戻しマルテンサイト組織 (母材とほぼ同じ組織)	マルテンサイト組織
(c)	7. 5	焼戻しマルテンサイト組織 (母材とほぼ同じ組織)	ソルバイト組織
(d)	10. 0	焼戻しマルテンサイト組織 (母材とほぼ同じ組織)	微細マルテンサイト組織 (母材とほぼ同じ組織)

[0035]Although omitted for details, although what is necessary is just to have set quantity of APUSSETTO after welding to  $0.1d-0.8d$  when [ said ] comparing and setting the path of weld line material to  $d$ , many experimental results and, in order to obtain the most desirable mechanical properties of a joined part, it found that  $0.4d-0.5d$  were desirable.

[0036]As stated above, [ the welding machine and welding process of this invention composition ] After welding to a wire rod by usual comparing, since APUSSETTO between heat is performed, [ the neighborhood of a welding part ] Since recovery of deterioration of the mechanical properties by welding heat is achieved and the path of a joined part becomes thicker than the diameter of a base material by APUSSETTO simultaneously, it can carry out the above equivalent to it of a base material as breaking force of weld line material, or equivalent. Thereby, rather than the conventional welding process, the wire rod of a byway can be used and a weight saving is attained.

[0037]Since the spindle type joined part whose diameter the welding part expanded by using 2 rate electrodes which have the opening in which the welding side edge expanded the diameter of the wire rod grasping part of an electrode is obtained, Even if the fall of mechanical strength arises in a welding part, a base material part and the breaking force more than equivalent are acquired by the increase in a cross-section area, and the breaking force of a base material is guaranteed as a hoop line.

[0038]Since the welding machine of this invention performs automatically APUSSETTO after the above-mentioned welding and welding by condition setup, it can economize and mass production becomes easy.

[0039]Although the electrode which has an opening was used for the welding side edge in the above-mentioned embodiment, even if it uses the electrode which has only the usual parallel part slot in which this opening is not provided, recovery and the diameter expansion effect of the mechanical properties of said joined part can be planned by performing APUSSETTO suitable after welding of this invention.

[0040]

[Effect of the Invention]as explained above, according to the butt welding method and welding machine of a high intensity wire rod of this invention, also in 1 turn hoop line using a high intensity wire rod, etc., it has the breaking force of a base material, and the breaking force of the welding part more than equivalent, since it compares and welding is possible, The wire rod of a byway can be used and it is lightweight and more economical than the steel rod wire rod by the conventional welding process.

[0041]Since reliable 1 turn hoop line of high breaking force is acquired, it can transpose to the hoop line of a continuation volume, on-site processing becomes easy, and a man day and cost are reduced.

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[Translation done.]